From core belief challenge to posttraumatic growth in para sport athletes: moderated mediation by needs satisfaction and deliberate rumination

Purpose: To examine how deliberate rumination and psychological need satisfaction interact to facilitate posttraumatic growth for para sport athletes with acquired disability. **Methods:** Utilizing a sample of 70 para sport athletes, the hypothesized mediating role of deliberate rumination was examined via a simple mediation model. The interaction between needs satisfaction and deliberate rumination and their effect on posttraumatic growth was examined utilizing a moderated mediation procedure. **Results:** Disruption to one's core beliefs was significantly associated with posttraumatic growth. This relationship, was in part, explained by the deliberate rumination engaged in soon after the trauma. Needs satisfaction, while a significant predictor of posttraumatic growth, did not moderate the indirect effect. **Conclusions:** Although deliberate rumination at both timeframes and needs satisfaction were independently associated with posttraumatic growth, they did not interact in the hypothesized manner to influence posttraumatic growth. There remains a need to better understand how the experience of posttraumatic growth is achieved amongst individuals with acquired disability, and the role that para sport may play in this process.

Keywords: adaptive sport; physical activity; disability; organismic valuing theory

Introduction

The study of psychological adaptation following an acquired physical disability has largely focused on adverse reactions evident in the disability aftermath. Indeed, acquiring a disability is a traumatic experience often accompanied by deleterious consequences, such as posttraumatic stress disorder (PTSD), depression, anxiety, body image issues, social discomfort, and diminished life satisfaction [1,2]. For example, in an investigation examining PTSD symptoms of individuals with spinal cord injury and amputations, mean PTSD scores exceeded levels of clinical significance both in the immediate post-injury period, and during a follow-up occurring at least one month later [3]. While such responses are neither uncommon nor unexpected, an

exclusive focus on undesirable outcomes fails to capture the full breadth of potential reactions to physical disability. In fact, numerous examples illustrate the possibility of experiencing positive psychological changes following an acquired disability, such as a greater appreciation of life, enhanced meaning, and improved social relationships [4–7].

The notion of positive psychological change occurring as the result of challenging life events has been termed posttraumatic growth [8]. Posttraumatic growth has been observed in a number of populations, such as combat veterans [9] and cancer survivors [10]. Importantly, posttraumatic growth scholars have argued that it is not the challenging event itself that precipitates growth, but rather an individual's negative reaction to the event that serves as the catalyst for psychological growth [8,11]. Perceptions of helplessness, uncontrollability, and life threat caused by an event are likely to precede posttraumatic growth [12]. Conversely, being resilient in the face of trauma has been shown to be inversely related with posttraumatic growth [13]. This finding is likely due to the fact that resilient individuals may experience less disruption than their fragile counterparts, leaving little necessity or opportunity for posttraumatic growth [14]. Consequently, an event must cause disruption in order to precipitate growth. The terminology often adopted by posttraumatic growth theorists to describe the disruption that causes one to reexamine fundamental views about how the world works and one's place in it is a *shattering of one's assumptive world*, also referred to as a challenge to one's core beliefs [15].

In support of theorizing that this existential crisis precedes growth, empirical research has demonstrated the link between challenge to core beliefs and posttraumatic growth [16,17]. The experience of posttraumatic growth, however, is not an inevitable outcome of having one's core beliefs challenged. Rather, growth requires substantial cognitive effort. This cognitive processing has typically been conceptualized in terms of rumination, that is, frequent thoughts concerning

the trauma [8,18]. Furthermore, ruminative thought occurring in the aftermath of trauma can take multiple forms; including intrusive thoughts which are unsolicited and often undesired, and deliberate thoughts which are purposeful and controlled attempts at making sense of the traumatic experience [19,20]. Cognitive processing, represented by these two forms of rumination, has received considerable attention in the posttraumatic growth literature [20–23]. Research illustrates that of these two forms of rumination, the deliberate type is the primary mechanism through which growth is experienced [22]. That is, challenged core beliefs that lead to deliberate ruminations are more likely to prompt posttraumatic growth.

The challenge to one's core beliefs and the important role it plays in the development of posttraumatic growth, as well as the cognitive processing necessary to experience growth, is embodied in two of the most prominent and comprehensive theories of posttraumatic growth: the functional-descriptive model of posttraumatic growth [8,24] and the organismic valuing theory of growth through adversity [11]. Specifically, the functional descriptive model describes how a trauma can act as a "seismic" event which threatens one's core beliefs, resulting in ruminations as one attempts to process the trauma. Similarly, according to organismic valuing theory, a traumatic event resulting in incongruence between one's previous core beliefs and new trauma information prompts a need to process the trauma information in such a way that either assimilates it into an existing worldview or accommodates it to create a new world view. Both theories posit that this initial processing of the trauma can be intrusive and distressful, but psychosocial factors play a role in promoting more constructive processing. For instance, in organismic valuing theory, Joseph and Linley posit that the extent that one's post-trauma social environment satisfies or thwarts an individual's fundamental psychological needs for competence, autonomy, and relatedness, will influence the extent to which that individual

engages in effortful appraisal processing, a concept akin to the deliberate ruminative thought conceptualized in the functional-descriptive model. The satisfaction of these innate needs is considered to be essential for psychological growth, integrity, and well-being [25].

Research involving individuals with acquired disabilities who participate in para sport (i.e., sport for people with disabilities) has provided support for the major tenets of the functional-descriptive model and organismic valuing theory. For instance, due to difficulties in adjusting to functional impairment, changing social roles, feelings of incompetence, loss of identity, and other psychosocial difficulties, acquiring a physical disability has been shown to disrupt fundamental world views and core beliefs [6,7]. Para sport participation was also found to facilitate growth outcomes. For example, in a qualitative study of seven Paralympic hopefuls with acquired disability, Day [6] found that participants sought to discover meaning from their experiences, which was aided by their para sport involvement. In another study, Hammer and colleagues [7] conducted interviews with 14 elite para triathletes (8 male, 6 female) and found that para sport served to facilitate posttraumatic growth, in part, by providing an environment in which fundamental needs could be satisfied. Other studies have similarly demonstrated the needs satisfaction role of para sport [26,27]. As sport affords one the opportunity to be self-determining, receive competence feedback, and to be socially involved, the utility of sport in satisfying psychological needs has been established [28].

The role of para sport as it relates to cognitive processing has also been illustrated in the literature. Day [6] found that participants re-created meaning through rumination, which was aided by para sport participation. Specifically, para sport helped participants to understand the significance of their experiences by providing the opportunity to reestablish pre-disability identities and to actively create new life meanings, which were reinforced through athletic

success and rewards. Likewise, in a study of 12 individuals with spinal cord injury who either participated or attempted to participate in para sport, Crawford and colleagues [5] emphasized the influencing role of para sport participation on injury relevant processing, specifically as it related to the creation of new identities or reestablishment of old ones.

While the literature supports the efficacy of para sport as a means to facilitate posttraumatic growth, the exact mechanisms through which this growth occurs remain poorly understood. Specifically, the aforementioned studies highlight the utility of para sport in satisfying psychological needs and facilitating trauma-related cognitive processing following challenges to one's core beliefs. However, a gap remains concerning the relationship between these two constructs. Although organismic valuing theory contends that needs satisfaction is a necessary component for engaging in effortful appraisal processing - a concept ostensibly analogous with deliberate rumination - organismic valuing theory is not explicitly clear as to the nature of this relationship. As such, there is a need to develop a comprehensive understanding of the role that these theoretically important concepts play in the development of posttraumatic growth. Several studies in the posttraumatic growth literature have previously established the mediating role of deliberate rumination on the experience of growth [22,29], yet these same studies frequently disregard variables that may possibly buffer or inflate these post trauma experiences. As posited by organismic valuing theory, psychological needs satisfaction may be one such variable. The present study sought to address this limitation by taking into account the potential moderating role of needs satisfaction, allowing for a more comprehensive model of the experience of posttraumatic growth to emerge. Building on previous literature, the purpose of this investigation was to further understand how needs satisfaction and cognitive processing interact to facilitate posttraumatic growth for individuals with acquired disability who participate

in para sport. To the authors' best knowledge, the constructs of needs satisfaction and cognitive processing as they relate to posttraumatic growth have yet to be empirically investigated concurrently, a gap we sought to address in the current study.

Consistent with the theoretical tenets of the functional-descriptive model of posttraumatic growth and the organismic valuing theory, as well as research findings, it was hypothesized that challenges to one's core beliefs would be positively related to subsequent posttraumatic growth (Hypothesis 1). Furthermore, as many studies in the realm of trauma have found support for the role of cognitive processing as a mediator between challenged core beliefs and posttraumatic growth, it was hypothesized that deliberate rumination would be the mechanism (i.e., mediator) through which this relationship could be explained in the present investigation. Specifically, based on preliminary research [30], deliberate rumination occurring at two separate time points was posited to mediate the relationship between core belief challenge and posttraumatic growth. That is, deliberate rumination occurring soon after trauma (Hypothesis 2a), as well as deliberate rumination brought about by recent para sport participation (Hypothesis 3a), were hypothesized to mediate the relationship between core belief challenge and posttraumatic growth. Additionally, we anticipated that the strength of this mediating effect would be contingent on the extent to which one's psychological needs were met through para sport participation. For the case of deliberate rumination occurring soon after trauma, it was hypothesized that needs satisfaction would moderate the path from deliberate rumination to posttraumatic growth (Hypothesis 2b), such that a stronger relationship between deliberation rumination (soon after trauma) and posttraumatic growth would be evident when greater need satisfaction was present (see figure 1). For the indirect effect of challenged core beliefs on posttraumatic growth through deliberate rumination brought about by para sport, it was hypothesized that psychological needs

satisfaction afforded through para sport participation would moderate both the path to and the path from deliberate rumination (Hypothesis 3b). Specifically, we expected that challenges to core beliefs would be more likely to precipitate deliberate rumination brought about by para sport, when para sport was facilitative of basic needs satisfaction. Similarly, deliberate rumination brought about by sport involvement was expected to predict heightened posttraumatic growth in instances where para sport participation facilitated need satisfaction. The hypothesized moderated mediation model is shown in figure 2.

[Insert both figure 1 and figure 2 near here]

It is hoped that findings from this study will provide a more nuanced understanding of the factors that facilitate posttraumatic growth, as well as the potential role of para sport participation. As posttraumatic growth is not a universal outcome for those who have suffered a trauma, it may be helpful to recognize factors that foster growth so that health care practitioners can identify and work with those who might be ready to experience posttraumatic growth [31]. Moreover, as research suggests that para sport may be an efficacious means to promote posttraumatic growth, results of this study can foster a deeper theoretical understanding of the mechanisms that make para sport participation effective.

Methods

Procedure

Following institutional review board approval, participants were recruited electronically through various disability sport organizations, as well as through the first authors' personal contacts. Participants were initially asked to read an informed consent form before completing an anonymous survey. All measures were completed electronically at the participants' discretion.

Participants

Prospective participants were required to be at least 18 years old, have an acquired disability, and participate in para sport. A total of 70 participants met these criteria and participated in the study. Several different disability classifications (e.g., visual impairment, traumatic brain injury, amputation, spinal cord injury) as well as para sports (e.g., triathlon, cycling, sled hockey, wheelchair basketball) were represented in the sample. Participant demographics and injury characteristics can be seen in table 1.

[Insert table 1 near here]

Measures

Challenge to Core beliefs

The Core Beliefs Inventory [16] was utilized to measure challenges to core beliefs experienced following the disabling event. Consisting of nine items scored on a six-point Likert scale ranging from 0 (*not at all*) to 5 (*to a very great degree*), the inventory asks participants to rate the magnitude to which an event led them to examine their core beliefs. The Core Beliefs Inventory has exhibited construct validity [16], and multiple studies have provided support for its internal consistency [17,22]. In the current investigation, Cronbach's alpha was .86.

Cognitive processing

The cognitive processing of the trauma, conceptualized as the ruminations one experiences, was assessed using the Event Related Rumination Inventory [20]. Rated on a four-point Likert scale ranging from 0 (*not at all*) to 3 (*often*), the Event Related Rumination Inventory is a two-factor, 20-item instrument that provides scores for how often an individual engages in deliberate and

intrusive ruminations in the aftermath of a highly stressful or traumatic event. As this study was concerned with the role of deliberate rumination in the attainment of posttraumatic growth, only the deliberate items were retained. Additionally, the inventory is designed to provide a measure of rumination at two different time frames, "during the weeks immediately after the event" and "during the last couple of weeks." While the wording for the initial time frame was unchanged, the second temporal condition was modified to "during and/or due to recent para sport participation" in order to account for our interest in deliberate ruminations brought about by recent para sport participation. The construct validity, factor structure, as well as the internal consistency of the Event Related Rumination Inventory has received empirical support [20,22,23]. In the present investigation, Cronbach's alpha was .87 for deliberate rumination occurring "during the weeks immediately after the event," and .94 for deliberate rumination occurring "during and/or due to recent para sport participation."

Needs satisfaction

Needs satisfaction was measured using the Basic Needs Satisfaction in Sport Scale [32]. The Basic Needs Satisfaction in Sport Scale is a 20-item instrument measured on a scale ranging from 1 (*not true at* all) to 7 (*very true*), which provides scores for competence, relatedness, as well as three separate categories of autonomy (i.e., volition, choice, and internal perceived locus of control). Initial psychometric support for the instrument included content, factor, and nomological validity, as well as internal consistency and test-retest reliability [32]. Although the Basic Needs Satisfaction in Sport Scale is a five-factor instrument, organismic valuing theory does not distinguish between the individual factors of psychological needs in terms of their importance to posttraumatic growth. Furthermore, according to Self-Determination Theory, psychological needs are considered to be inter-dependent [25]. Hence, our interest in the present

investigation was to examine a global indicator of needs satisfaction. As such, a composite score of the Basic Needs Satisfaction in Sport Scale items was used. Previous research consistently demonstrates strong inter-correlations between the psychological needs of competence, autonomy, and relatedness, and there is a precedent for assessing needs satisfaction as a uni-dimensional factor or composite score of the three needs [33–35], including studies utilizing the Basic Needs Satisfaction in Sport Scale [36,37]. Cronbach's alpha for the composite instrument was .88.

Posttraumatic growth

Perceptions of posttraumatic growth were assessed using the Posttraumatic Growth Inventory [38]. The Posttraumatic Growth Inventory consists of 21 items that provide a total posttraumatic growth score, as well as scores for each of its five factors: relating to others, new possibilities, personal strength, spiritual change, and appreciation for life. Items are rated on a six-point Likert scale from 0 (*I did not experience this change as a result of my crisis*) to 5 (*I experienced this change a very great degree as a result of my crisis*). The content validity of the Posttraumatic Growth Inventory has received support [39] and the internal consistency of the instrument has been exhibited in multiple studies [23,38]. The present investigation utilized only the total Posttraumatic Growth Inventory score. Cronbach's alpha for the total instrument was .93.

Analysis

All analyses were conducted using IBM SPSS 24. Approximately 2.2% of the data were missing. As Little's MCAR Test confirmed that data were missing completely at random ($\chi^2 = 90.82$, df = 104; p = .818), the expectation maximization algorithm was applied to replace missing data. Results of the Shapiro Wilk test indicated that the assumption of normality was violated by the

Basic Needs Satisfaction in Sport Scale, Posttraumatic Growth Inventory, and the deliberate rumination brought about by para sport scale ($p < .05$), so the expectation maximization procedure for items from those scales was conducted based on a student's t distribution. As the Core Beliefs Inventory and deliberate rumination occurring soon after trauma scales did not violate the normal distribution, the expectation maximization for those scales was based on a normal distribution. We then began the analyses by examining associations between variables of interest by performing bivariate correlations. To test our first hypothesis concerning the relationship between core belief challenge and posttraumatic growth, we also conducted a simple linear regression. In order to test our second and third hypotheses concerned with mediation and moderated mediation, the PROCESS macro for SPSS developed by Hayes [40] was employed. PROCESS estimates direct and indirect effects in mediation models, as well as the conditional effects in moderated mediation models, through ordinary least squares regression. For inference about the significance of indirect effects and conditional indirect effects (i.e., moderated mediation), PROCESS produces bias-corrected bootstrap confidence intervals based on a designated number of bootstrap samples (the present investigation used 10,000 bootstrap samples for all analyses). An effect is significant when zero is not contained within the confidence interval. For conditional indirect effects PROCESS provides regression coefficients for all relevant terms, including the interaction, as well as confidence intervals for values of the moderator corresponding to the 10^{th}, 25^{th}, 50^{th}, 75^{th}, and 90^{th} percentile (which can be interpreted as *very low*, *low*, *moderate*, *high*, and *very high*).

Results

Correlations as well as descriptive statistics for the measures used in this study can be found in table 2. Results suggest that acquiring a disability caused participants to challenge their core

beliefs to a "moderate" degree. Similarly, participants engaged in intermediate amounts of deliberate rumination at both time points. Participants perceptions of needs satisfaction through sport, however, was high, while posttraumatic growth was experienced to a "moderate" to "great" degree. The significant association between challenged core beliefs and deliberate rumination at both time points, as well as between both deliberate rumination scales and posttraumatic growth, was as expected. Basic needs satisfaction, however, was only significantly associated with posttraumatic growth. As predicted in hypothesis 1, results of the regression demonstrated that challenged core beliefs significantly predicted posttraumatic growth (standardized *ß* = .497, $t(68) = 4.719$, $p < .001$). Results of the regression suggest that challenged core beliefs accounted for 24.7% of the variance in posttraumatic growth ($R^2 = .247$, $F(1,68) = 22.268$, $p < .001$).

[Insert table 2 near here]

Simple Mediation Analyses

To test Hypothesis 2a, that challenged core beliefs would affect posttraumatic growth indirectly through deliberate rumination occurring soon after acquiring a disability, a simple mediation analysis using PROCESS [40] was conducted. The indirect effect is conceptualized as the product of the regression coefficient estimating deliberate rumination from challenged core beliefs (path *a* in figure 1) and the regression coefficient estimating posttraumatic growth from rumination when controlling for core beliefs (path *b* in figure 1). For the present sample, challenged core beliefs was found to influence deliberate rumination occurring soon after acquiring disability ($a = .222$, $p = .003$), and those who engaged in deliberate rumination exhibited greater posttraumatic growth ($b = .338$, $p = .027$). The bias-corrected bootstrap confidence interval for the indirect effect ($ab = .075$) was completely above zero (.016 to .180),

signifying that deliberate rumination occurring soon after acquiring disability mediated the relationship between challenged core beliefs and posttraumatic growth. However, the direct effect was significant (*c'* = .362, *p* < .001), indicating that challenges to core beliefs may still influence posttraumatic growth independent of its effect on deliberate rumination occurring soon after acquiring disability. The overall regression model accounted for 30.0% of the variation in posttraumatic growth (R^2 =.300, F(2,67) = 14.367, *p* < .001).

The same procedure was used to test Hypothesis 3a, that deliberate rumination brought about by para sport would mediate the relationship between core beliefs and posttraumatic growth. Similar to the prior mediation analysis, challenged core beliefs influenced deliberate rumination brought about by para sport involvement (*a* = .292, *p* = .001). However, deliberate rumination was not associated with posttraumatic growth when controlling for core beliefs (*b* = .090, *p* = .493). Contrary to our hypothesis, the indirect effect of core beliefs on posttraumatic growth through deliberate rumination brought about by para sport participation (*ab* = .026) was not significant, as the confidence interval contained zero (-.039 to .117). Once again, the direct effect of core beliefs on posttraumatic growth was significant (*c'* = .411, *p* < .001). The overall regression model accounted for 25.2% of the variation in posttraumatic growth (R^2 =.252, F(2,67) = 11.287, *p* < .001)

Moderated Mediation Analyses

The simple mediation analysis indicated that core beliefs had an indirect effect on posttraumatic growth through deliberate rumination occurring soon after trauma. In Hypothesis 2b, we posited that the magnitude of this indirect effect would be contingent on needs satisfaction experienced through para sport participation (see figure 1). This conditional indirect effect is estimated as the product of the effect of core beliefs on rumination and the conditional effect of rumination on

posttraumatic growth as a function of needs satisfaction. Utilizing ordinary least squares regression, the PROCESS procedure [40] calculates the values for each of these regression coefficients (see table 3). These regression coefficients can also be found in figure 3, which is the statistical representation of the conceptual model depicted in figure 1. Using these values from table 3, the equation for the conditional indirect effect of core beliefs on posttraumatic growth through deliberate rumination occurring soon after trauma at a specific value of needs satisfaction (BNSSS) was:

$$(.222)(.526 - .033*BNSSS) \quad (1)$$

PROCESS [40] provides these conditional indirect effects and conducts an inferential test at five different values of the moderator (i.e., 10th, 25th, 50th, 75th, and 90th percentile) by generating 95% bias-corrected confidence intervals of the full moderated mediation model, as can be seen in table 4. As shown in table 4, the indirect effect of challenged core beliefs on posttraumatic growth was significant at moderate (.073, SE = .041, 95% CI: [.015, .191]), high (.069, SE = .036, 95% CI: [.015, .164]), and very high (.067, SE = .040, 95% CI: [.007, .169]) levels of needs satisfaction. However, the regression coefficient for the interaction between deliberate rumination and needs satisfaction was not significant in predicting posttraumatic growth (coeff. = -.033, p = .851). While Hayes [40] contends that the statistically significant moderation of a path in a mediation model is not a prerequisite for moderated mediation to occur, these results nonetheless provide some doubt as to the moderating role of needs satisfaction. This reservation is verified by an insignificant index of moderated mediation (index = -.007, 95% CI: [-.076, .099]). The direct effect remained significant (c' = .294, p = .002). Furthermore, as can be seen in table 3, the overall regression model was significant, as it accounted for 42.9% of the variation in posttraumatic growth (R^2 =.429, F(4,65) = 12.207, p < .001).

[Insert table 3 near here]

[Insert figure 3 near here]

We used a similar procedure to test Hypothesis 3b. Although there was no evidence of a significant indirect effect of core beliefs on posttraumatic growth through deliberate rumination brought about by para sport, unmoderated mediation is not a necessary condition for moderated mediation to exist [40]. As the moderated mediation in figure 2 is slightly different than the model represented in figure 1 in that needs satisfaction is proposed to moderate two separate paths, the equation for the estimate of the conditional indirect effect is slightly different. That is, the conditional indirect effect is estimated as the product of the conditional effect of core beliefs on rumination as a function of needs satisfaction and the conditional effect of rumination on posttraumatic growth as a function of needs satisfaction. Using the values from table 3, the equation for the conditional indirect effect of core beliefs on posttraumatic growth through deliberate rumination brought about by para sport at a specific value of needs satisfaction (BNSSS) is:

$$(.742 - .077*\text{BNSSS})(.527 - .079*\text{BNSSS}) \quad (2)$$

As was the case in the previous analysis, the interactions were not significant (see table 3), suggesting that needs satisfaction was not a moderator of hypothesized relationships. Figure 4 provides a statistical diagram, including regression coefficients, of the model depicted in figure 2. Table 4 shows conditional indirect effects and 95% bias-corrected confidence intervals of the full moderated mediation model. As all confidence intervals included zero, none of the indirect effects were significant. As was the case with all the other models, the direct effect was significant ($c' = .348$, $p < .001$). Despite the lack of evidence for moderated mediation, the

overall regression model was significant, as it accounted for 38.4% of the variation in posttraumatic growth (R^2 =.384, F(4,65) = 10.117, p < .001).

[Insert figure 4 near here]

[Insert table 4 near here]

Discussion

The purpose of this investigation was to better understand how needs satisfaction and cognitive processing interact to facilitate posttraumatic growth for para sport athletes with acquired disability. We begin the discussion by examining the relationships between variables of interest in the study before considering whether or not our hypotheses were supported. As expected, challenged core beliefs was significantly correlated with deliberate rumination at both time points as well as with posttraumatic growth. Posttraumatic growth was significantly associated with deliberate rumination at both time points, as well as with needs satisfaction. The finding of positive relationships between challenged core beliefs, deliberate rumination, and posttraumatic growth is consistent with the tenets of the functional-descriptive model of posttraumatic growth as well as with research in the field [8,22]. Additionally, research demonstrates an association between needs satisfaction and posttraumatic growth [41]. Needs satisfaction, however, was not correlated with core belief challenge or with deliberate rumination at either time point. As this investigation was the first study we are aware of that empirically examined the relationship between needs satisfaction and deliberate rumination, we cannot compare our results to those of other studies. However, given that organismic valuing theory suggests that needs satisfaction would support effortful appraisal processing [11], the lack of association is unexpected. It may be that need satisfaction occurring in non-sport domains (e.g., interpersonal relationships) is more relevant in promoting the deliberate rumination needed for spurring posttraumatic growth.

Alternatively, it is possible that personal characteristics such as grit, hardiness, or resilience are more salient in stimulating particular forms of cognitive processing and subsequent posttraumatic growth. Future research is necessary to provide a more comprehensive understanding of the relationship between needs satisfaction and cognitive processing.

To examine interactions between needs satisfaction and cognitive processing in facilitating growth, we first examined distinct parts of the model before testing the whole moderated mediation model. As theory and research demonstrate that challenges to core beliefs are a necessary antecedent to posttraumatic growth, the first aim was intended to establish the relationship between core belief challenge and posttraumatic growth for the present sample. As hypothesized, a simple linear regression demonstrated a significantly positive relationship between challenge to core beliefs and subsequent posttraumatic growth. Across various populations, the literature is replete with similar findings that core belief challenge and posttraumatic growth are associated. Interestingly, in the present study, the relationship between core belief challenge and posttraumatic growth remained intact even when rumination and needs satisfaction variables were introduced into the models. That is, in all of the mediation and moderated mediation analyses we ran, the direct effect of core belief challenge on posttraumatic growth remained significant. These results imply that the relationship between core beliefs and posttraumatic growth cannot be completely explained by the other variables in the model (i.e., rumination, needs satisfaction, interactions between variables). Future research may consider investigating additional factors, such as emotional disclosure or challenge appraisal, in explaining the relationship between core belief challenge and posttraumatic growth.

The second and third hypotheses were concerned with the mediating role of deliberate rumination in the occurrence of posttraumatic growth following a disruption to core beliefs.

Specifically, in the second and third hypotheses we proposed two differing models to explain how posttraumatic growth is experienced. Hypothesis 2a posited that deliberate rumination occurring soon after trauma would be the mechanism through which growth is achieved, while hypothesis 3a proposed that posttraumatic growth is achieved through deliberate rumination brought about by para sport participation. Only Hypothesis 2a was supported by the results of the study. That is, although deliberate rumination at both time points was significantly correlated with posttraumatic growth, the relationship between core belief challenge and posttraumatic growth could only be explained through deliberate rumination occurring soon after trauma. This is in contrast to recent findings that both deliberate rumination occurring soon after trauma and deliberate rumination during recent para sport mediated the relationship between core belief challenge and posttraumatic growth [30].

In line with Hypotheses 2b and 3b, we tested the full moderated mediation model in which it was expected that needs satisfaction would moderate each of the simple mediation models illustrated in figures 1 and 2. In relation to Hypothesis 2b, results revealed an insignificant interaction effect, meaning needs satisfaction was not found to moderate the relationship between deliberate rumination and posttraumatic growth. The same was true for Hypothesis 3b. Therefore, while it was hypothesized that psychological needs satisfaction would maximize the effect of deliberate rumination on posttraumatic growth, results from the present investigation failed to support this hypothesis. Although Joseph and Linley [11] contend that effortful appraisal processes are influenced by social support processes such as needs satisfaction, they acknowledge that the nature of the influence is unknown. While it was hypothesized that the relationship would be one of moderation, results from the present investigation suggest that is not the case. Nonetheless, the total regression model predicting

posttraumatic growth from the moderated mediation models tested in Hypothesis 2b and Hypothesis 3b were statistically significant, accounting for 42.9% and 38.4% of the variance respectively. Additionally, needs satisfaction was a significant predictor of posttraumatic growth in both models. Therefore, even though the moderated mediation hypotheses were not supported, there is strong evidence of a significant relationship between the variables of interest and posttraumatic growth. That is, this study demonstrated the utility of needs satisfaction and deliberate rumination in predicting posttraumatic growth, but failed to identify the mechanisms through which their influence is exerted on growth. Future investigations should explore alternative models.

Despite the lack of support for one of the simple mediation hypotheses and the two moderated mediations, the collective results of this study are intriguing. First, informed by complex posttraumatic growth theories, this study sought to understand the processes that produce posttraumatic growth for individuals with acquired disability who participate in para sport. In utilizing these theories, this was the first study we know of to incorporate both needs satisfaction and deliberate rumination as predictor variables of posttraumatic growth. While these variables were independently associated with posttraumatic growth, they did not interact in the hypothesized manner to influence posttraumatic growth. This finding seemingly contradicts organismic valuing theory [11], which posits that needs satisfaction influences effortful appraisal processes, which in turn facilitates posttraumatic growth. Other studies that did not specifically take into account the deliberative ruminative processes as the present research did, however, have found support for the organismic valuing theory. For instance, in a sample of previously injured athletes, stress related growth mediated the relationship between two of the needs satisfaction domains (i.e., competence and relatedness) and subjective well-being [42]. Similarly,

a longitudinal study involving cancer patients found autonomy support was a significant predictor of posttraumatic growth at the latter time point [43]. Moreover, although previous investigations have found support for the facilitative role of para sport on the experience of posttraumatic growth, this study was among the first to examine the mechanisms by which para sport facilitates posttraumatic growth. While results suggest that deliberate rumination brought about by recent para sport participation as well as needs satisfaction afforded through para sports were significantly associated with posttraumatic growth, there was no evidence that the conceptual models involving these variables were statistically significant. It is possible that these variables exert their influence on posttraumatic growth through other personality (e.g., hardiness, optimism) or behavioral variables (e.g., proactive coping behaviors).

It is recognized there are a number of possible limitations in the current study. First, the sample was not very large. However, while bootstrapping techniques are not a "cure" for small samples, they are robust to violations of normality assumptions and they provide for higher statistical power. As the population of individuals who possess acquired disabilities and participate in para sport is relatively small compared to the general population, it follows that procuring large samples would be difficult. Of similar concern, the majority of the sample represented a small handful of para sports. Therefore, the generalizability of the findings warrants a degree of caution. Additionally, as with any self-report measure where participants are asked to remember past events, there exists the potential for recall bias. Furthermore, the methodology cannot infer causality due to the cross-sectional nature of the design. It is also possible that the theories informing this study failed to account for relevant variables influencing posttraumatic growth. Future studies may build off of this study's findings to examine other potential antecedents of posttraumatic growth among para sport athletes, such as psychological

needs satisfaction prior to the adverse event, personality traits, behavioral variables, or preservation of one's athletic identity during para sport participation. Lastly, a criticism of posttraumatic growth research is that posttraumatic growth is often implied to be the most constructive response to trauma, over other responses such as resilience [14]. In contrast to the core belief challenge characteristic of posttraumatic growth, resilient individuals tend to have the ability to maintain healthy psychological functioning following a trauma [44]. The stable trajectory of functioning afforded by resilience may be an equally or even more adaptive outcome than posttraumatic growth. Future studies may consider the utility of posttraumatic growth versus other potential responses to trauma.

Despite these limitations, the findings from the present investigation provide further insight into how posttraumatic growth is experienced, particularly for individuals with acquired disability who participate in para sport. This study was among the first to employ quantitative methodologies informed by theory to understand the development of posttraumatic growth for individuals with acquired disability. In summary, disruption to one's core beliefs was significantly associated with subsequent posttraumatic growth. This relationship, was in part, explained by the deliberate rumination engaged in soon after the trauma. The role that basic needs satisfaction afforded through para sport participation plays in this relationship, however, is less clear as it was found to be a significant predictor of posttraumatic growth, but not a moderator of the indirect effect. Similarly, the function of the deliberate cognitive processing prompted by para sport participation on the occurrence of posttraumatic growth requires further inquiry. As both of these variables were significantly associated with posttraumatic growth, there remains a need to better understand how the experience of posttraumatic growth is achieved

amongst individuals with acquired disability, and the role that para sport may play in this process.

Disclosure statement

The authors report no conflicts of interest.

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Figure 1. A conceptual diagram of a simple mediation model through deliberate rumination occurring soon after trauma with one path moderated by needs satisfaction.

Figure 2. A conceptual diagram of a simple mediation model through deliberate rumination brought about by para sport with two paths moderated by needs satisfaction.

Figure 3. A statistical diagram (containing regression coefficients) of the conditional process model depicted in Figure 1. CBI = Core Belief Inventory. DEL-SA = Deliberate rumination occurring soon after trauma. BNSSS = Basic Needs Satisfaction in Sport Scale; PTGI = Posttraumatic Growth Inventory.

Figure 4. A statistical diagram (containing regression coefficients) of the conditional process model depicted in Figure 2. CBI = Core Belief Inventory. DEL-Sport = Deliberate rumination brought about by para sport participation. BNSSS = Basic Needs Satisfaction in Sport Scale; PTGI = Posttraumatic Growth Inventory.

Table 1. Characteristics of Sample (N=70)		
Variables		**Values, mean +/- SD OR n (%)**
Age; mean +/- SD (years)		40.7 +/- 11.2
Gender		
	Male	48 (68.6%)
	Female	22 (31.4%)
Race		
	White	61 (87.1%)
	Hispanic, Latino, or Spanish	4 (5.7%)
	Black or African American	2 (2.9%)
	Native Hawaiian and other Pacific Islander	1 (1.4%)
	Two or more races	1 (1.4%)
	Prefer not to answer	1 (1.4%)
Education		
	High school graduate, diploma, or the equivalent (e.g., GED)	6 (8.6%)
	Some college credit, no degree	6 (8.6%)
	Trade, technical, or vocational training	4 (5.7%)
	Associates degree	3 (4.3%)
	Bachelors degree	25 (35.7%)
	Advanced degree	25 (35.7%)
	Prefer not to answer	1 (1.4%)
Veteran		
	No	51 (72.9%)
	Yes	19 (27.1%)
Years disabled; mean +/- SD		14.4 +/- 8.9
How disability was acquired		
	Traumatic accident, non-military	39 (55.7%)
	Acute injury	3 (4.3%)
	Result of military combat	6 (8.6%)
	Degenerative condition or illness	10 (14.3%)
	other	12 (17.1%)
Years of para sport participation; mean +/- SD		6.8 +/- 6.0
Weekly hours participating in para sport; mean +/- SD		11.3 +/- 6.1
Para sport level of competition		
	Paralympic Games	10 (14.3%)
	International competitions	13 (18.6%)
	National championships	25 (35.7%)
	Regional competitions	9 (12.9%)
	Local/recreational competitions	13 (18.6%)

Table 2. Descriptive statistics and correlations among measured variables in moderated mediation models

Variable	1	2	3	4	5	Mean	SD
1. CBI	*.856*					2.90	1.11
2. Deliberate – Soon After	.345**	*.873*				1.77	0.71
3. Deliberate – Para Sport	.378**	.359**	*.941*			1.43	0.86
4. BNSSS	.218	.102	.165	*.877*		5.98	0.68
5. PTGI	.497**	.388**	.255*	.465**	*.932*	3.29	0.98

Note: N = 70. * $p < .05$; ** $p < .01$. Cronbach's alphas are shown in italics on the diagonal. CBI = Core Belief Inventory; BNSSS = Basic Needs Satisfaction in Sport Scale; PTGI = Posttraumatic Growth Inventory

Table 3. Regression coefficients and standard errors for the moderated mediation models

	Figures 1 and 3		Figures 2 and 4	
	DEL-SA Coeff (SE)	PTGI Coeff (SE)	DEL-Sport Coeff (SE)	PTGI Coeff (SE)
Constant	1.124*** (.227)	-1.611 (1.817)	-1.228 (1.971)	-1.557 (1.467)
CBI	.222** (.073)	.294** (.090)	.742 (.689)	.348*** (.094)
DEL-SA	-	.526 (1.088)	-	-
BNSSS	-	.580^{+} (.298)	.311 (.331)	.630* (.250)
DEL-Sport	-	-	-	.527 (1.025)
DEL-SA x BNSSS	-	-.033 (.175)	-	-
CBI x BNSSS	-	-	-.077 (.113)	-
DEL-Sport x BNSSS	-	-	-	-.079 (.169)
	R^2 = .119 F(1,68)=9.208, p=.003	R^2 = .429 F(4,65)=12. 207, p<.001	R^2 = .156 F(3,66)=4.0 70, p=.010	R^2 = .384 F(4,65)=10. 117, p<.001

Note: $^{+}$ $p < .10$; * $p < .05$; ** $p < .01$; *** $p < .001$. SE = standard error. CBI = Core Belief Inventory. DEL-SA = Deliberate rumination occurring soon after trauma. DEL-Sport = Deliberate rumination brought about by para sport participation. BNSSS = Basic Needs Satisfaction in Sport Scale; PTGI = Posttraumatic Growth Inventory

Table 4. Conditional indirect effects of core belief challenge on posttraumatic growth through deliberate rumination at levels of basic needs satisfaction

	Deliberate rumination occurring soon after			Deliberate rumination brought about by para sport		
BNSSS Percentile	Indirect Effect	Bootstrap *SE*	95% BC Bootstrap CI	Indirect Effect	Bootstrap *SE*	95% BC Bootstrap CI
10th (5.10)	.0793	.0672	[-.0330, .2363]	.0431	.0777	[-.0825, .2370]
25th (5.55)	.0761	.0516	[-.0016, .2130]	.0276	.0482	[-.0518, .1487]
50th (5.95)	.0731	.0409	[.0151, .1906]	.0160	.0356	[-.0442, .1022]
75th (6.50)	.0691	.0363	[.0152, .1636]	.0031	.0422	[-.0680, .1119]
90th (6.80)	.0669	.0403	[.0071, .1693]	-.0024	.0518	[-.1076, .1084]

Note: BNSSS = Basic Needs Satisfaction in Sport Scale. *SE* = standard error. BC Bootstrap CI = Bias corrected bootstrap confidence interval. Number of bootstrap samples for confidence intervals: 10,000.